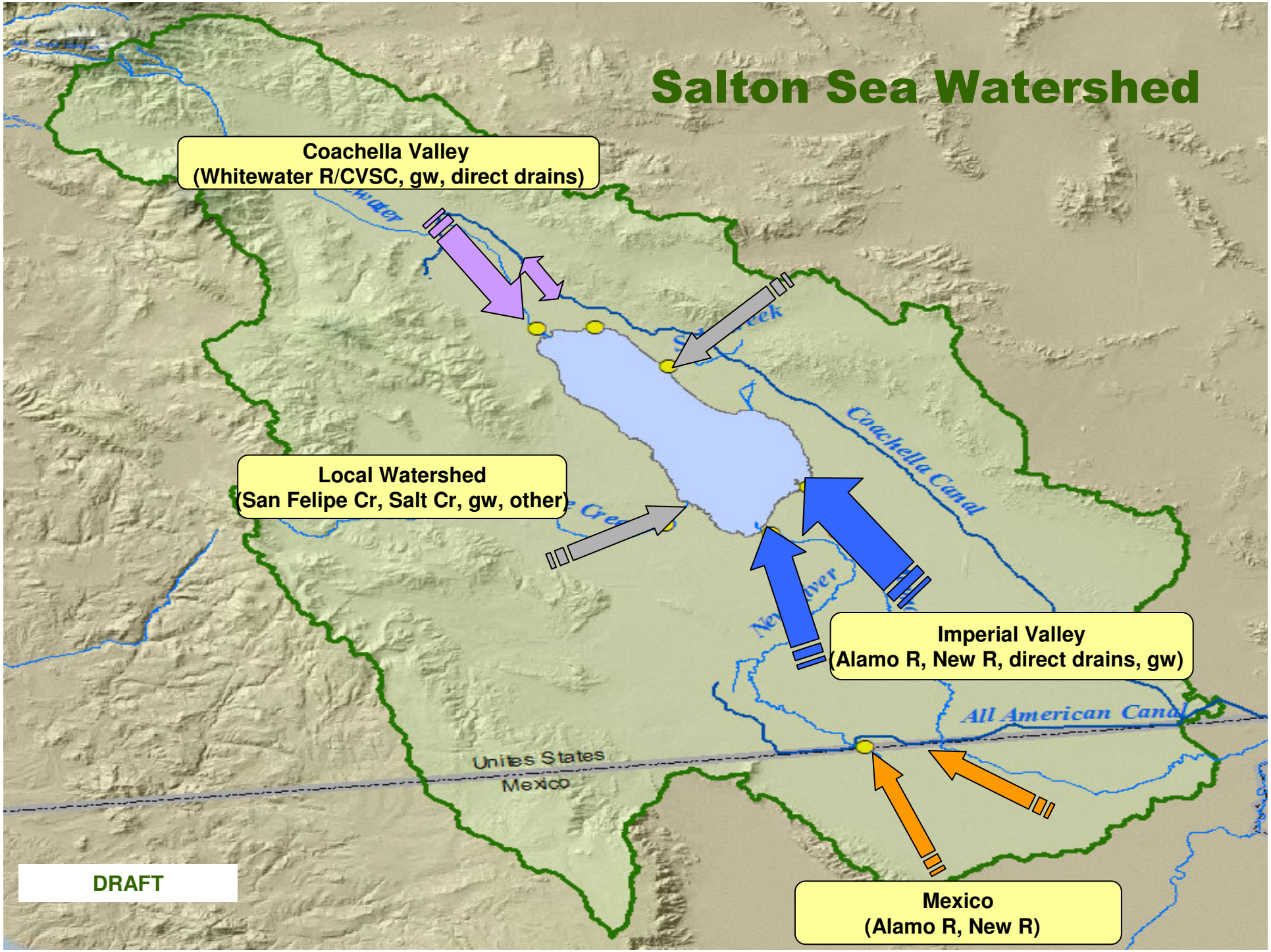
APPROACHES TO DEVELOPMENT OF SALTON SEA HYDROLOGIC MONITORING AND ASSESSMENT PLAN (MAP)

UC Riverside
Palm Desert, CA
March 26, 2008

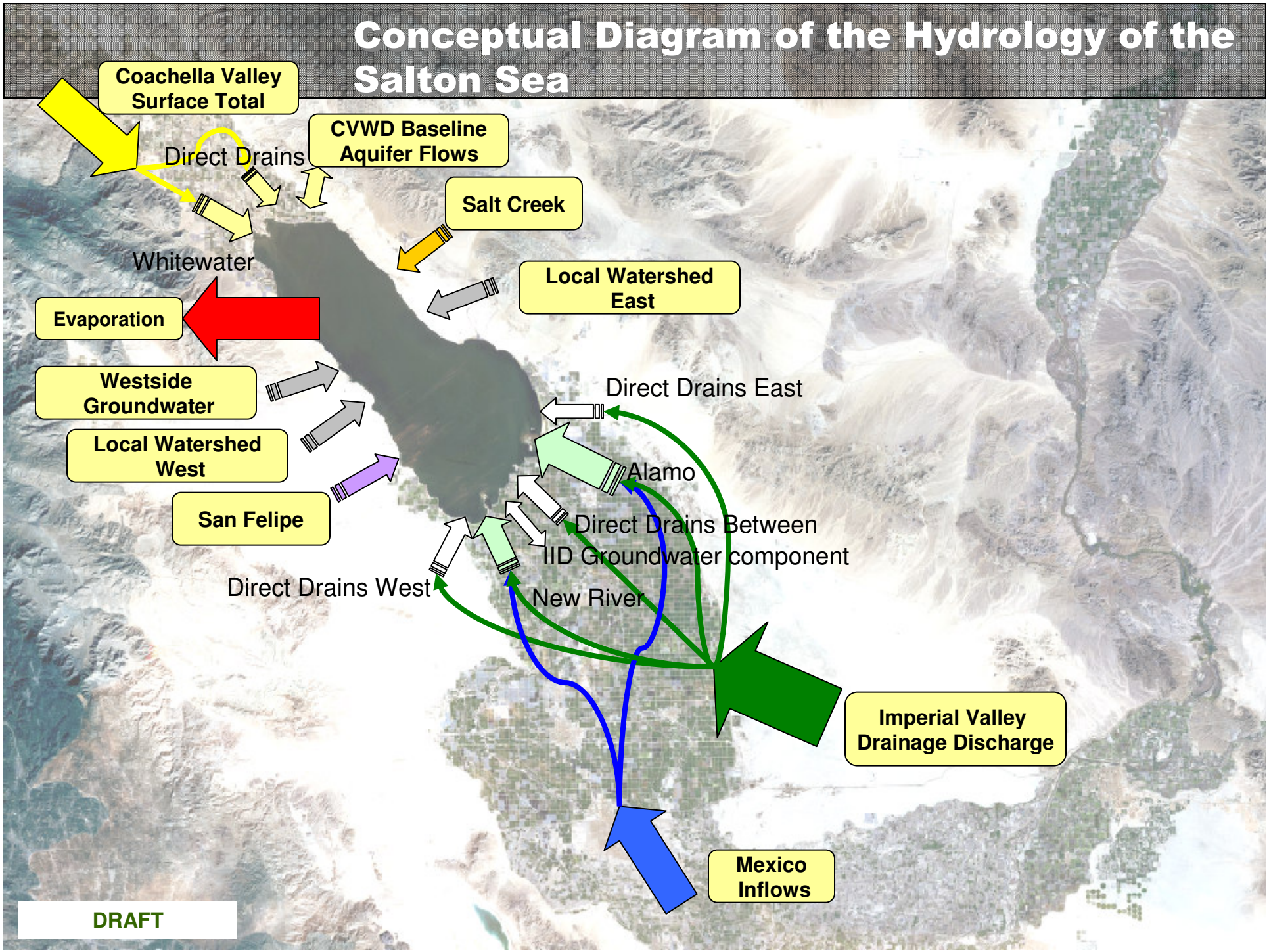
Monitoring Plan Objectives

- **Hydrologic Monitoring Plan Goal**
  - Implement a data collection, analysis, management, and reporting system to inform and guide management actions for hydrologic resources of the Salton Sea ecosystem.
- **Hydrologic Monitoring Plan Objectives**
  - Assess and incorporate existing monitoring activities and data into a long-term monitoring program for hydrologic resources of the Salton Sea;
  - Determine the condition, variability, and trends of hydrologic resources associated with the Salton Sea ecosystem;
  - Establish benchmarks against which data gathered during long-term monitoring can be compared;
  - Provide information to refine hypotheses of hydrologic functions and processes;
  - Identify and prioritize existing data gaps, collect data using standardized methods and techniques to fill these voids, and facilitate storage, management, and distribution of data in a timely manner; and
  - Integrate planning, data collection, analysis, and management activities with all other resource groups.

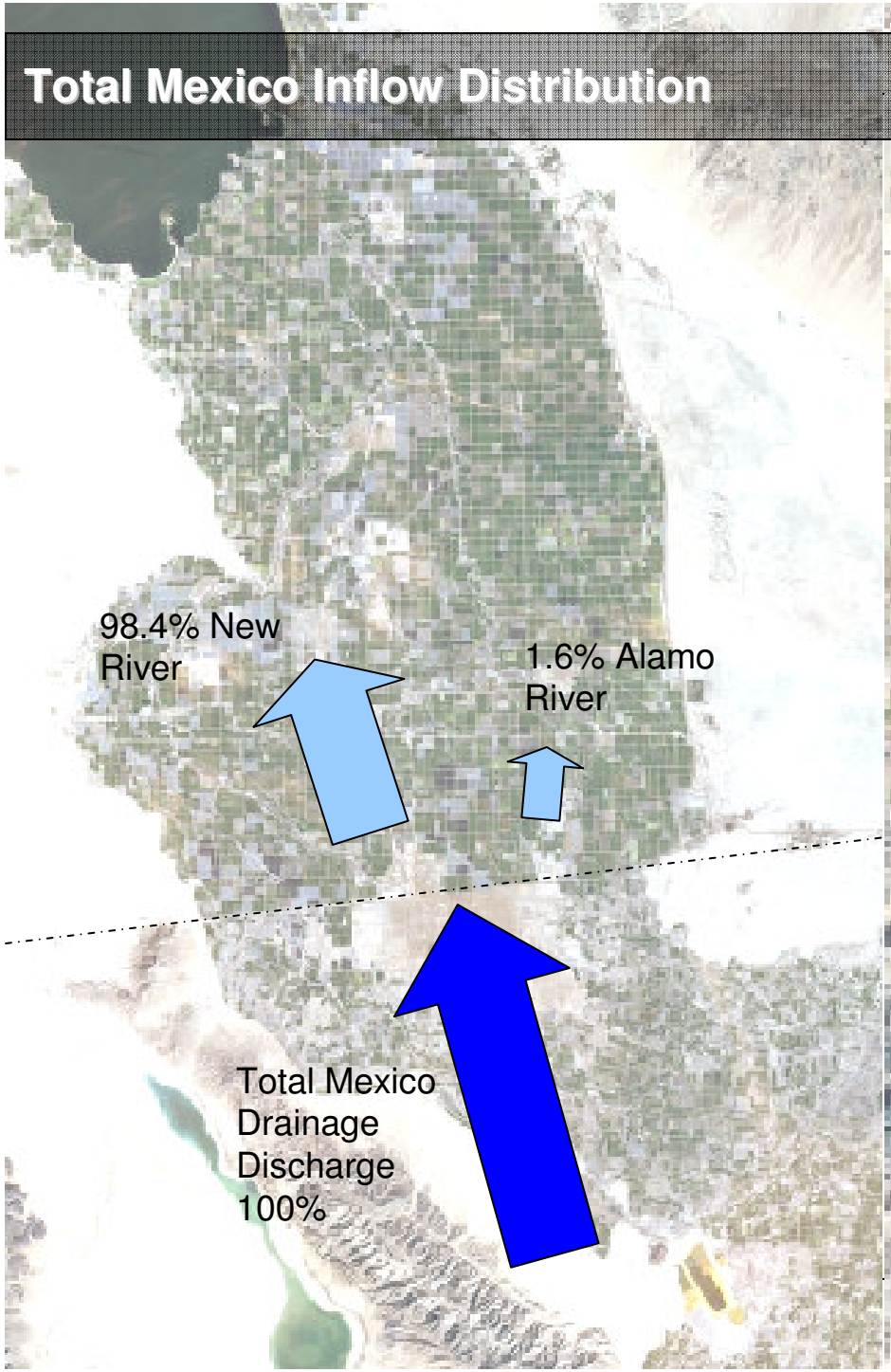

Salton Sea Watershed
Coachella Valley
(Whitewater R/CVSC, gw, direct drains)
Local Watershed
(San Felipe Cr, Salt Cr, gw, other)
Imperial Valley
(Alamo R, New R, direct drains, gw)
Mexico
(Alamo R, New R)
Coachella Canal
All American Canal
United States
Mexico
DRAFT

Relative Historic Contribution of Inflow Sources

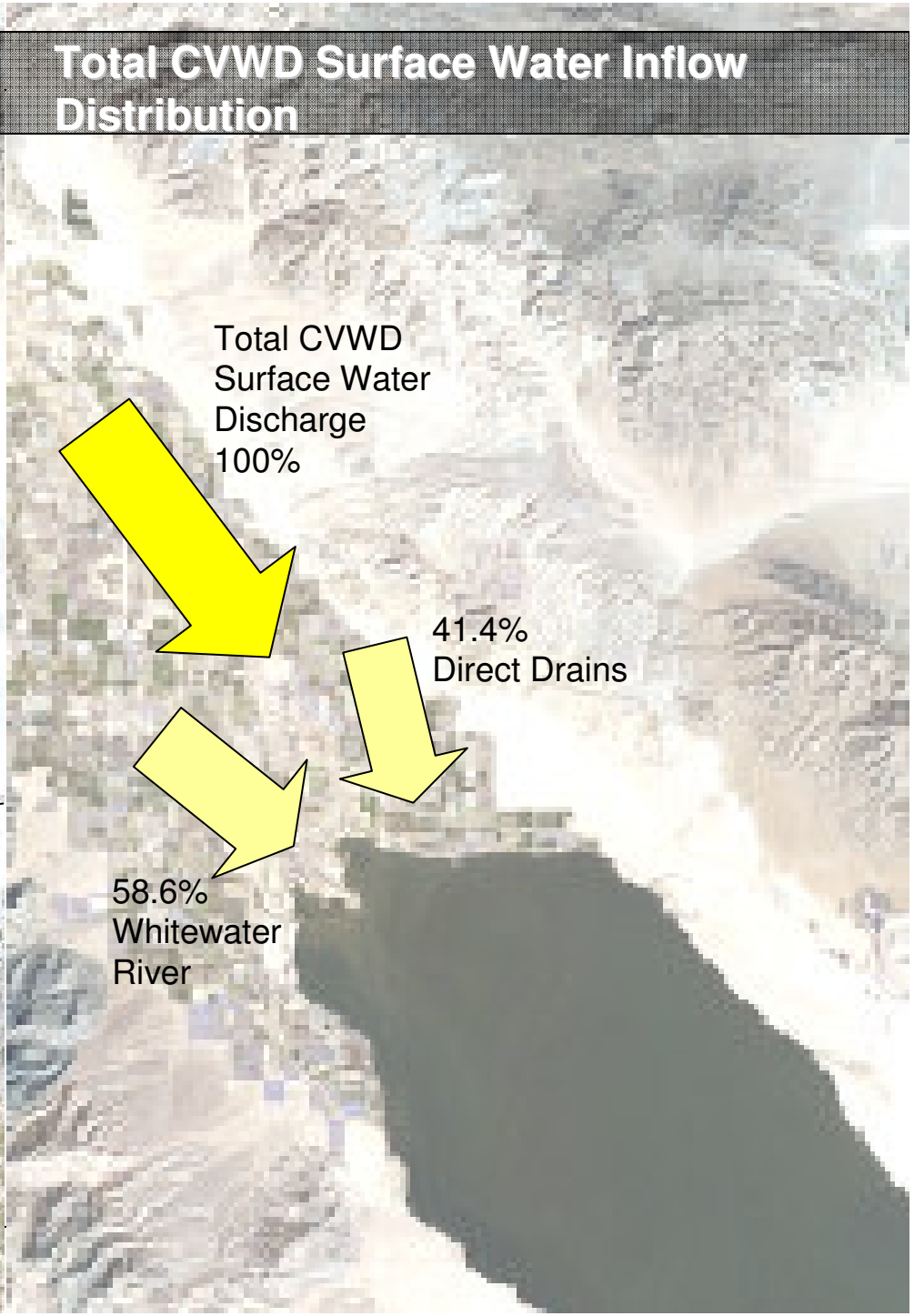
Inflow Source to the Salton Sea	Percent of Historical Annual Average Inflow
Mexico	**9.8%**
Imperial Valley	**76.5%**
Coachella Valley	**8.5%**
Local Watershed	**1.5%**
Precipitation directly on the Salton Sea	**3.7%**
TOTAL	**100.0%**


Conceptual Diagram of the Hydrology of the Salton Sea
Coachella Valley Surface Total
Direct Drains
CVWD Baseline Aquifer Flows
Salt Creek
Whitewater
Local Watershed East
Evaporation
Westside Groundwater
Direct Drains East
Local Watershed West
Alamo
San Felipe
Direct Drains Between IID Groundwater component
Direct Drains West
New River
Imperial Valley Drainage Discharge
Mexico Inflows
DRAFT

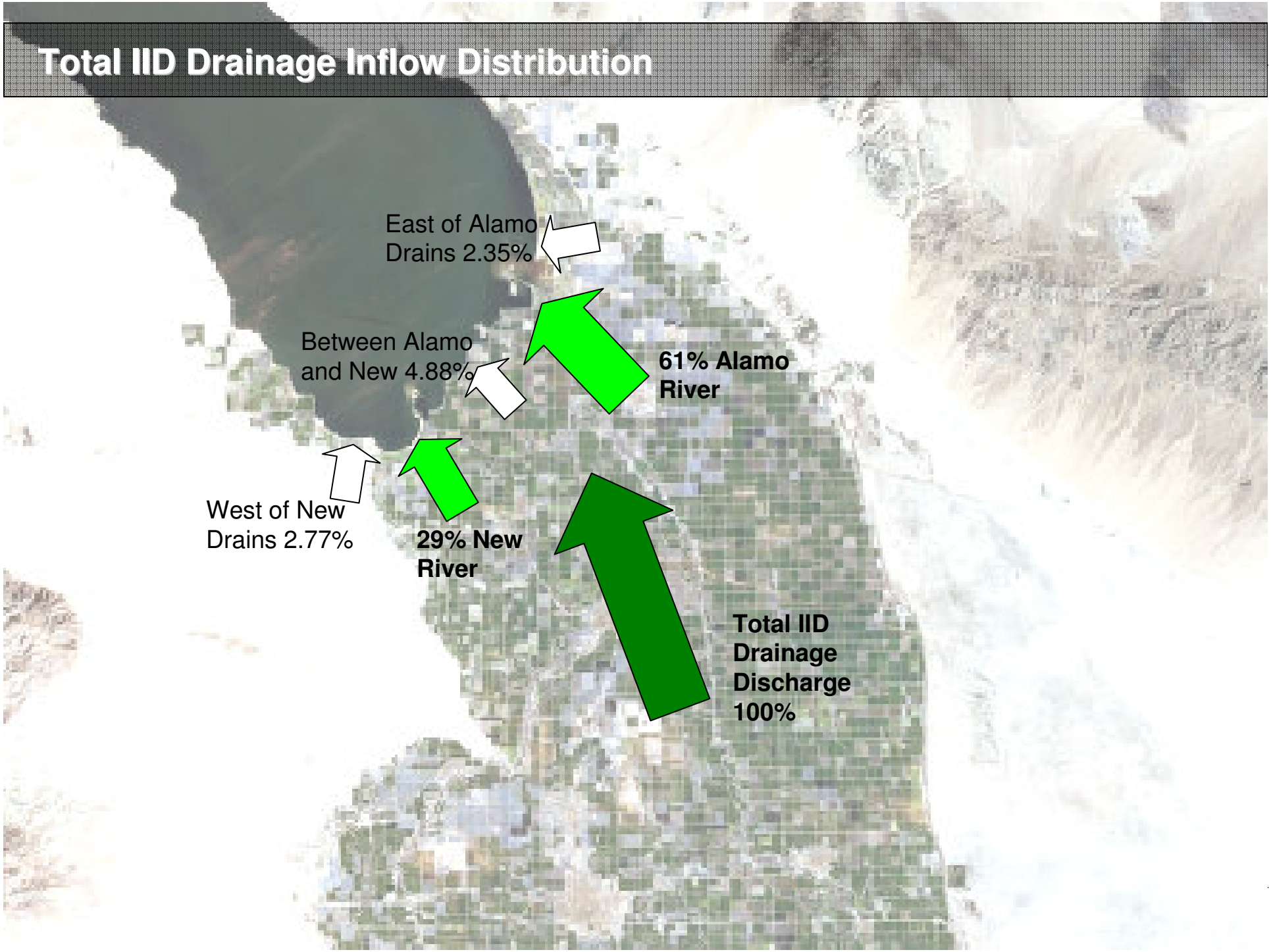
Total Mexico Inflow Distribution



Total CVWD Surface Water Inflow Distribution



Total IID Drainage Inflow Distribution



Current Surface Water Flow Monitoring at the Salton Sea

Source	Location	Agency	Frequency
Alamo River	International Boundary	IID, IBWC	C
Alamo River	near Niland	USGS 10254730	C
New River	International Boundary	USGS 10254970	C
New River	near Westmoreland	USGS 10255550	C
Whitewater River/CVSC	near Mecca	USGS 10259540	C
Salt Creek	0.3 mi u/s Sea	USGS 10255550	C
San Felipe Creek	near Westmoreland	USGS 10255885	Discontinued

Current Surface Water Flow Monitoring at the Salton Sea

Source	Location	Agency	Frequency
IID Drains	7 major drains	IID	M
IID Drains	18 minor drains	IID	Q
IID Drains	29 direct drains	IID	M, study
CV Drains	??		

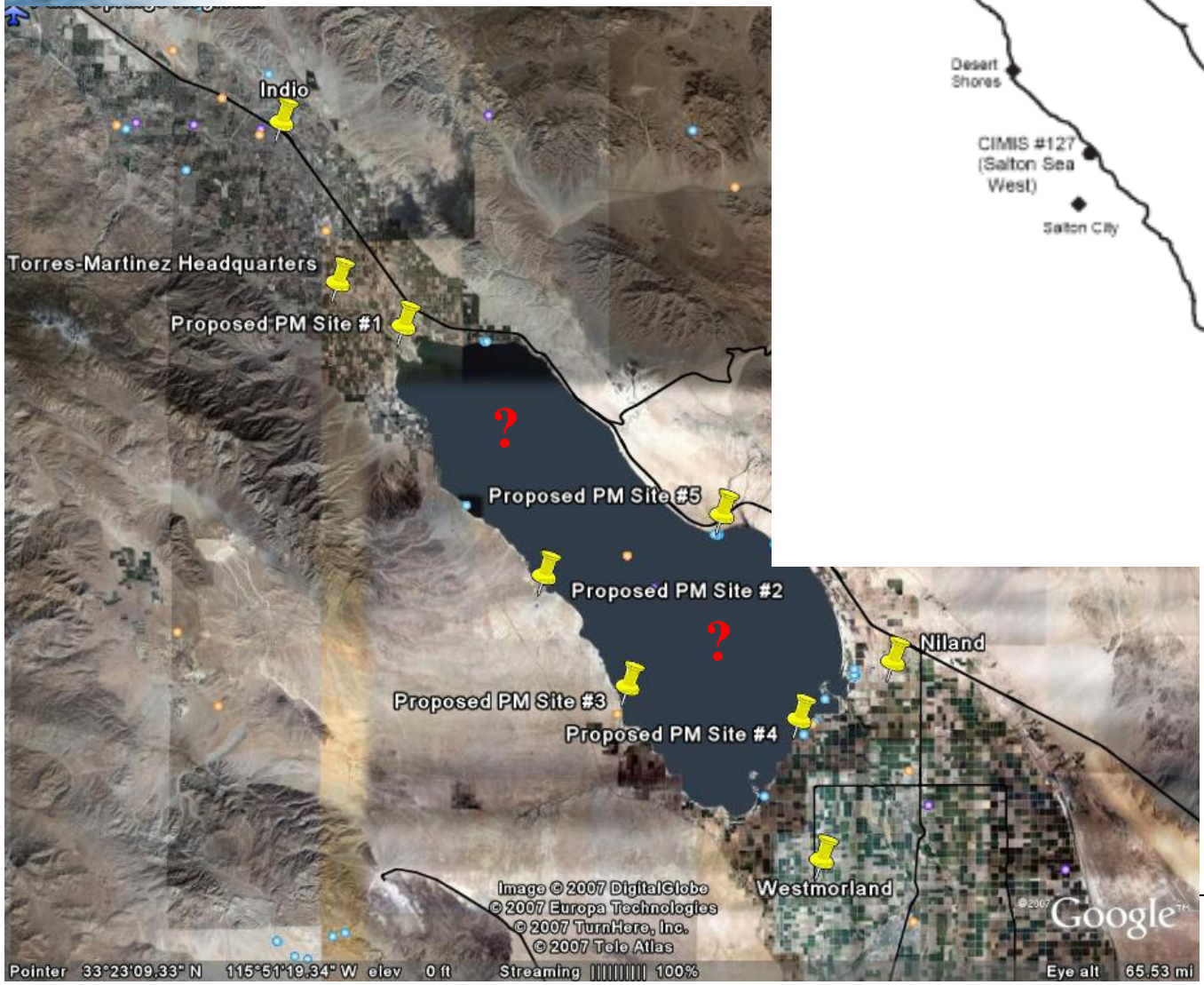
Current Meteorological and Other Physical Monitoring at the Salton Sea

Parameters	Location	Agency	Frequency
Wind, precipitation, air temperature, shortwave/longwave radiation, relative humidity, etc	Niland, State Park, Salton Sea West, Oasis, Mecca, Calipatria	DWR/CIMIS	C
Pan Evaporation	Imperial Salt Farm, Devil's Hole, Three Flags	IID	M, A ?
Salton Sea W.S. Elevation		USGS 10254005	D

Monitoring Gaps

- Species Conservation Habitat (shallow, saline ponds located on seabed)
  - Imperial Valley direct drains
  - Coachella Valley direct drains
  - Groundwater characterization and shallow groundwater fluxes
- Marine sea and shallow water hydraulics
  - Denser met data network (specifically wind)
  - Sea temperature, velocity
  - Continuous long-term monitoring velocity, temperature, elevation, salinity

CIMIS Network linked with Proposed Air Quality Network



Salton Sea Groundwater

Monitoring Network Objectives

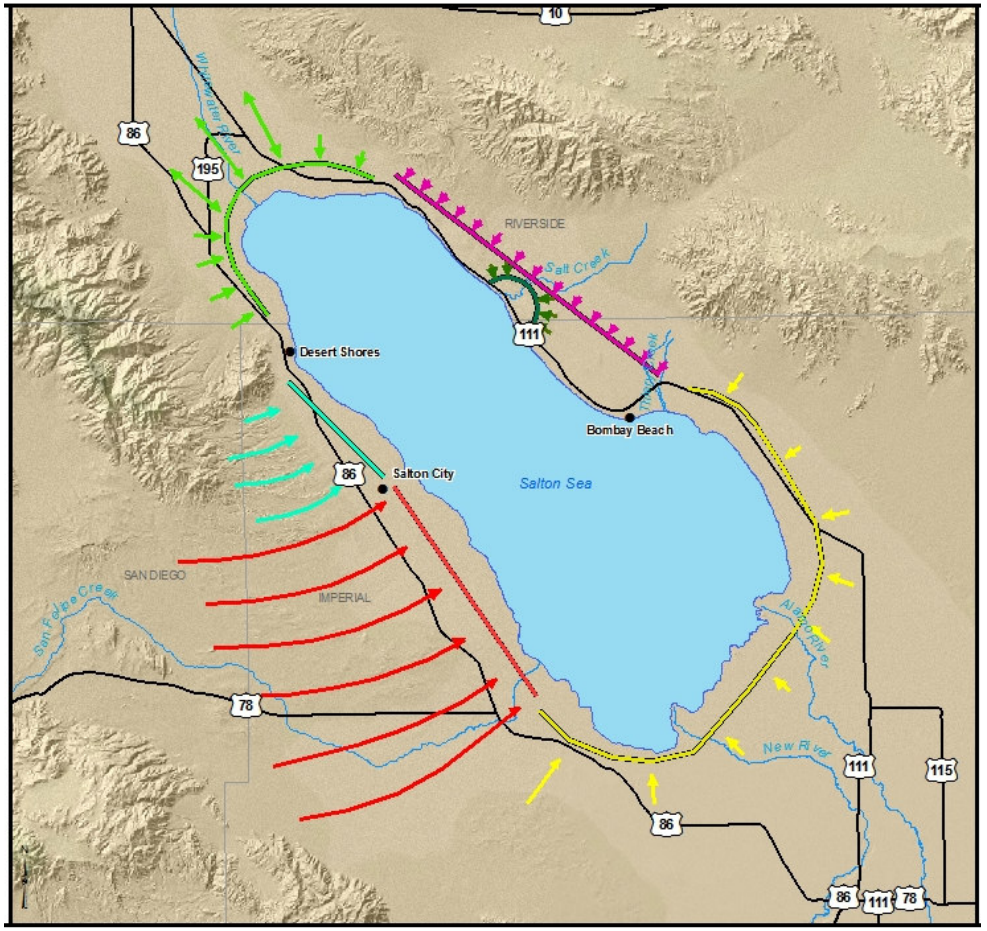
- Define groundwater elevation, flow directions, and chemistry to enable evaluation of future changes to the Salton Sea system
- Confirm existing (baseline) groundwater conditions.
- Monitor changes in groundwater system.
- Identify and evaluate constructability issues associated with saline habitat development and future alternatives for Salton Sea Restoration.
- Utilize groundwater information to evaluate future alternatives.

Background – Other Studies

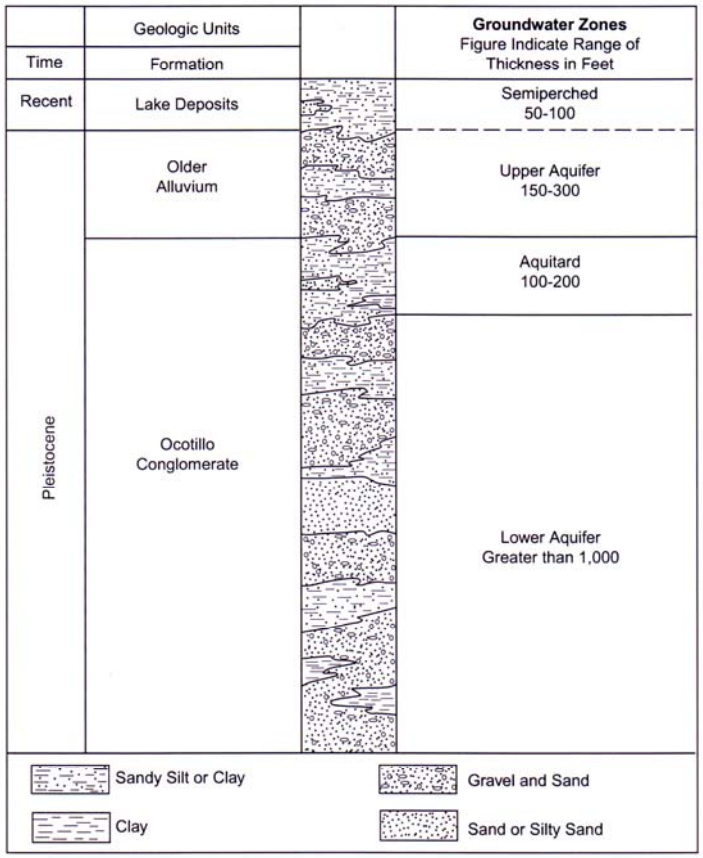
- LLNL
- USGS
- Tetra Tech
- Others

Background – Current Understanding

- Closed basin
- Groundwater discharges to sea
- Current groundwater contribution (AF)
- Future groundwater contribution (AF)



Hydrostratigraphy – Coachella Valley



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MONTGOMERY WATSON HARZA

Figure 6-2
Conceptual Hydrostratigraphy for the Coachella Valley

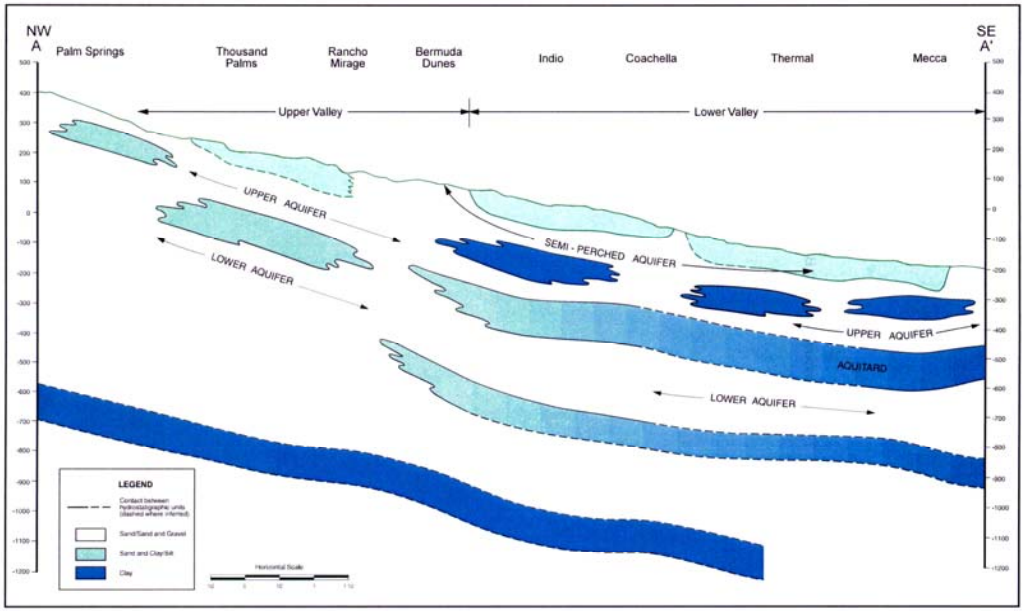
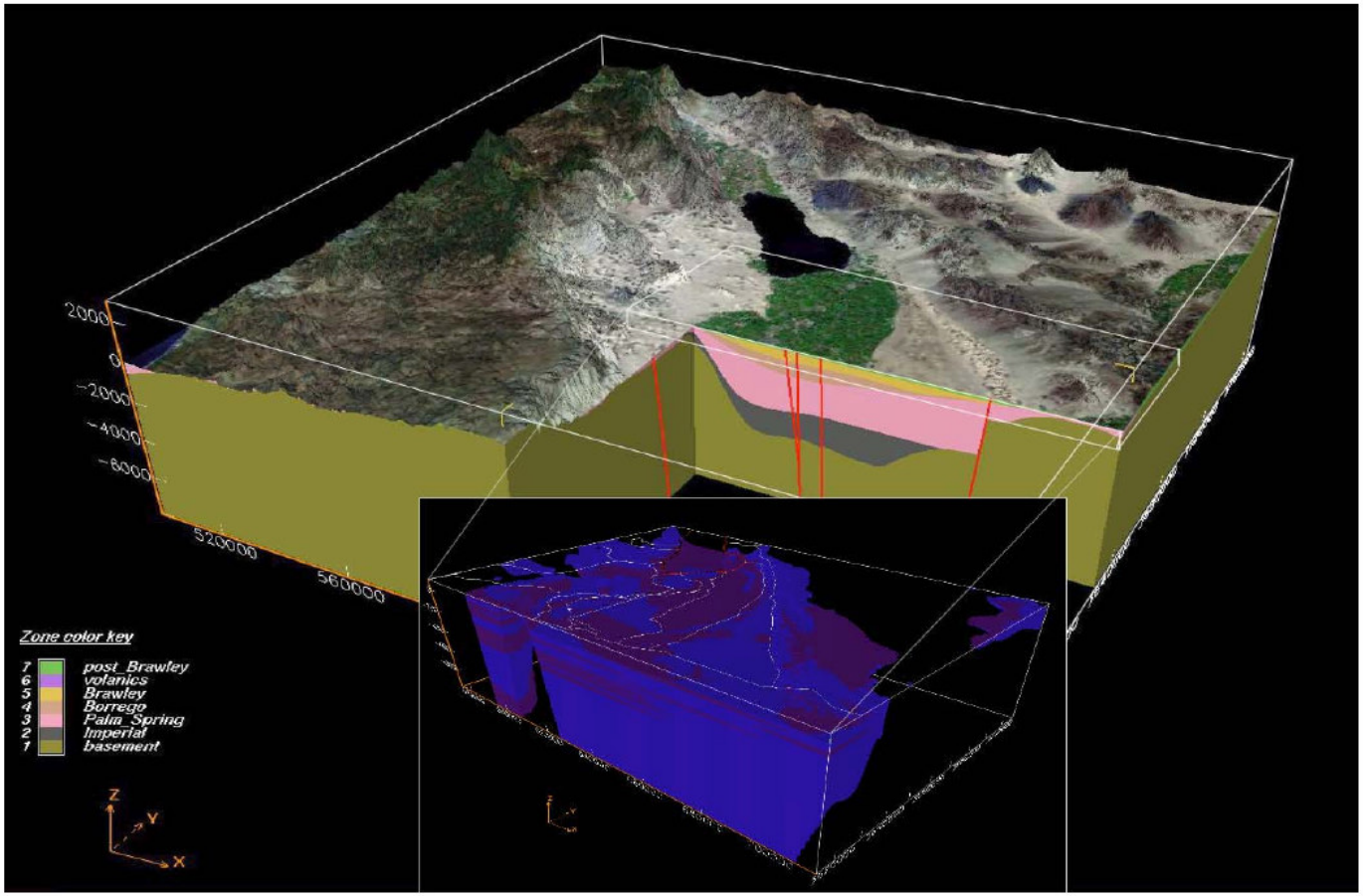


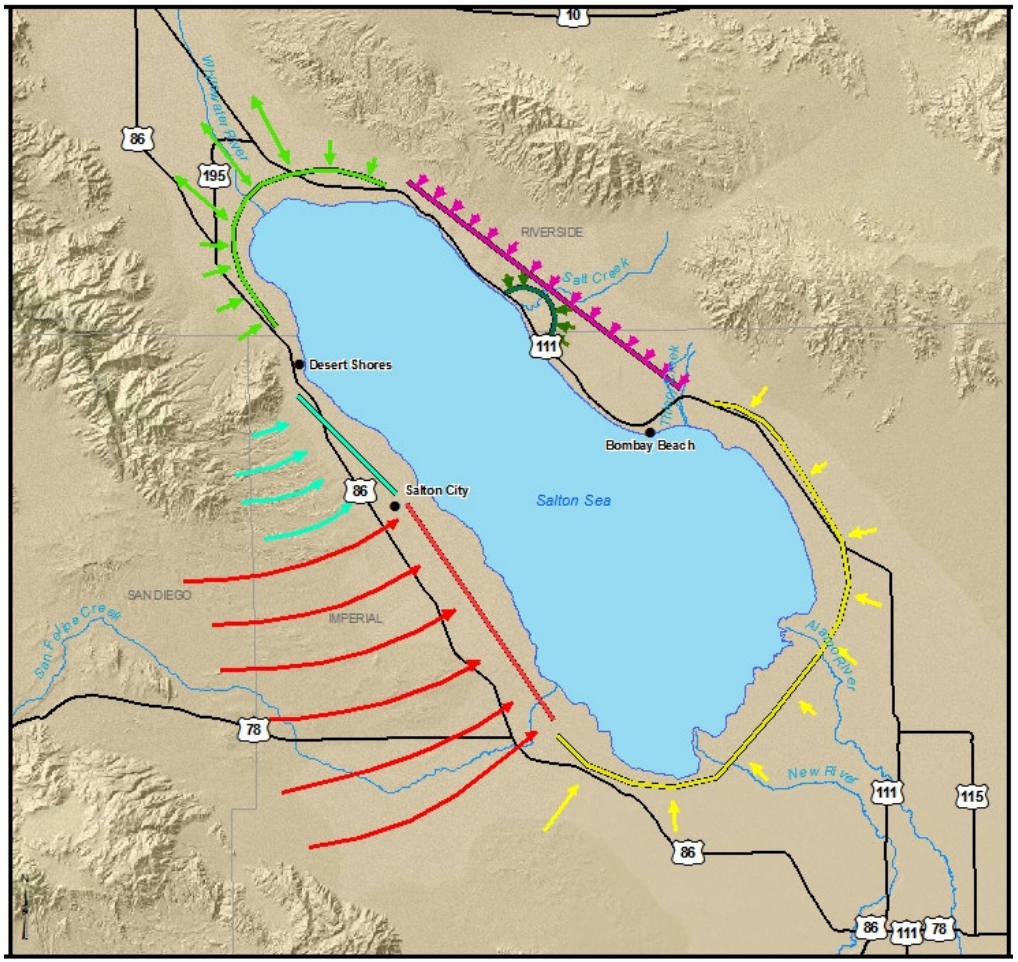
Figure 6-3
Conceptual Hydrogeologic Cross Section for the Coachella Valley

Hydrostratigraphy – Southern Salton Sea



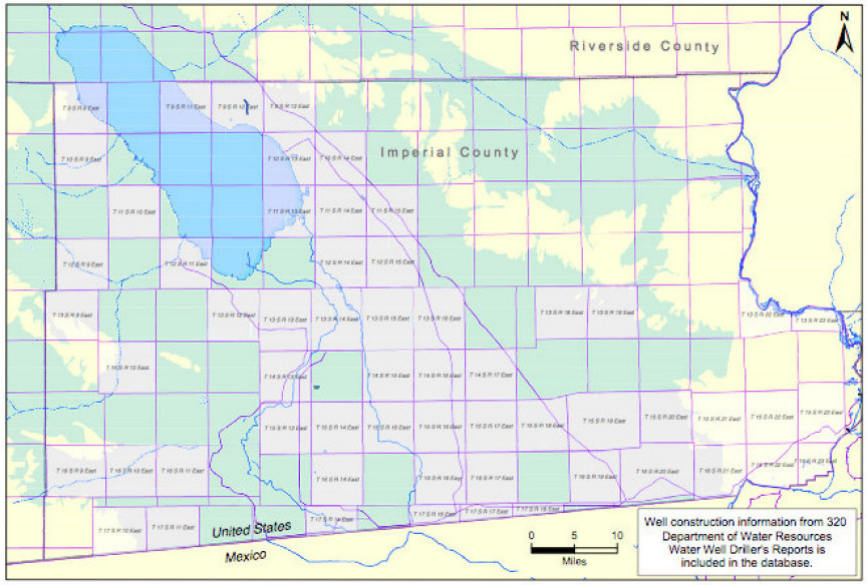
Conceptual Flow Zones

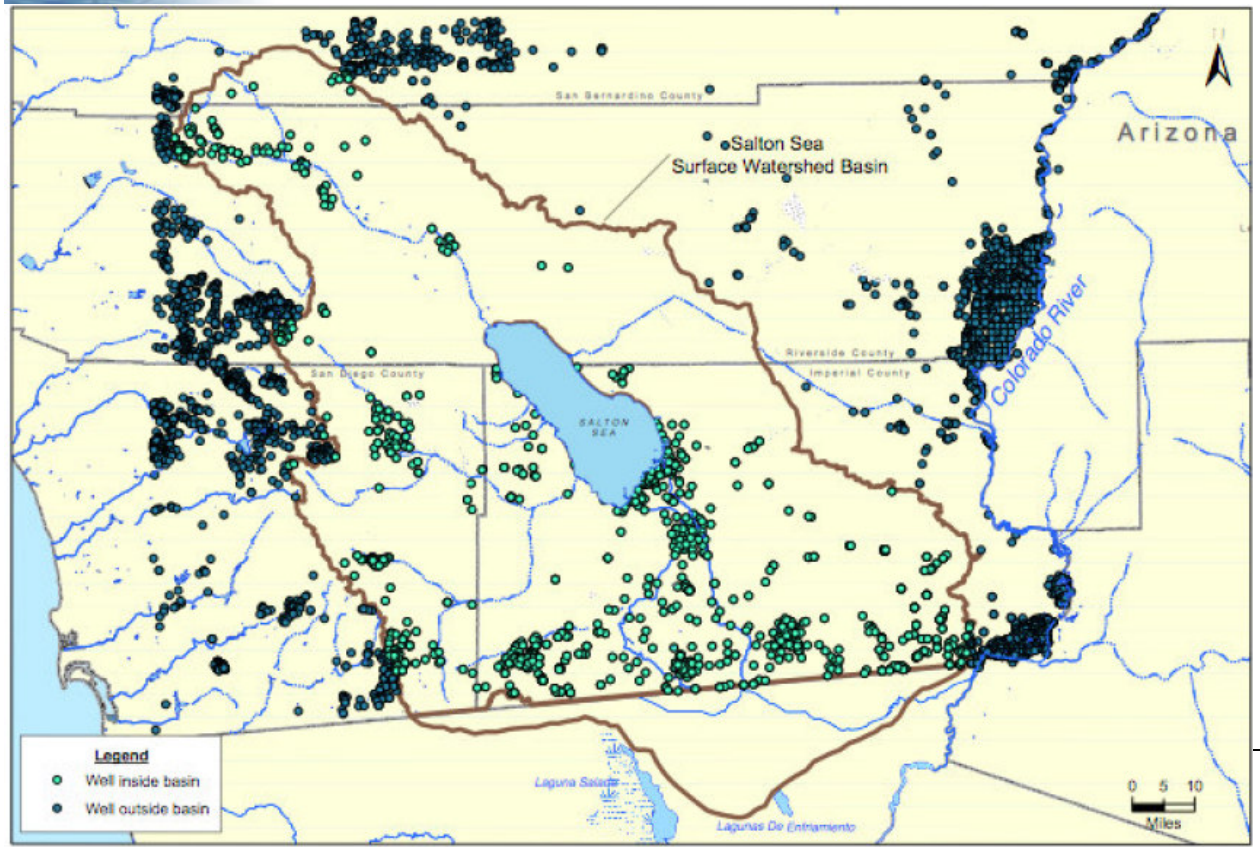
- Coachella Valley
- Mountain Front (Desert Shores to Salton City)
- Badlands / San Felipe Creek
- Imperial Valley & Agricultural Drainage
- Salt Creek
- East Sea Springs
- Deep Groundwater Upwelling



Available Data

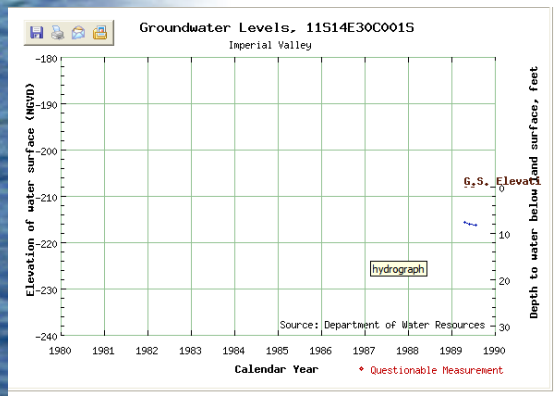
- LLNL wells





Publicly Available

- DWR
- USGS
- Others



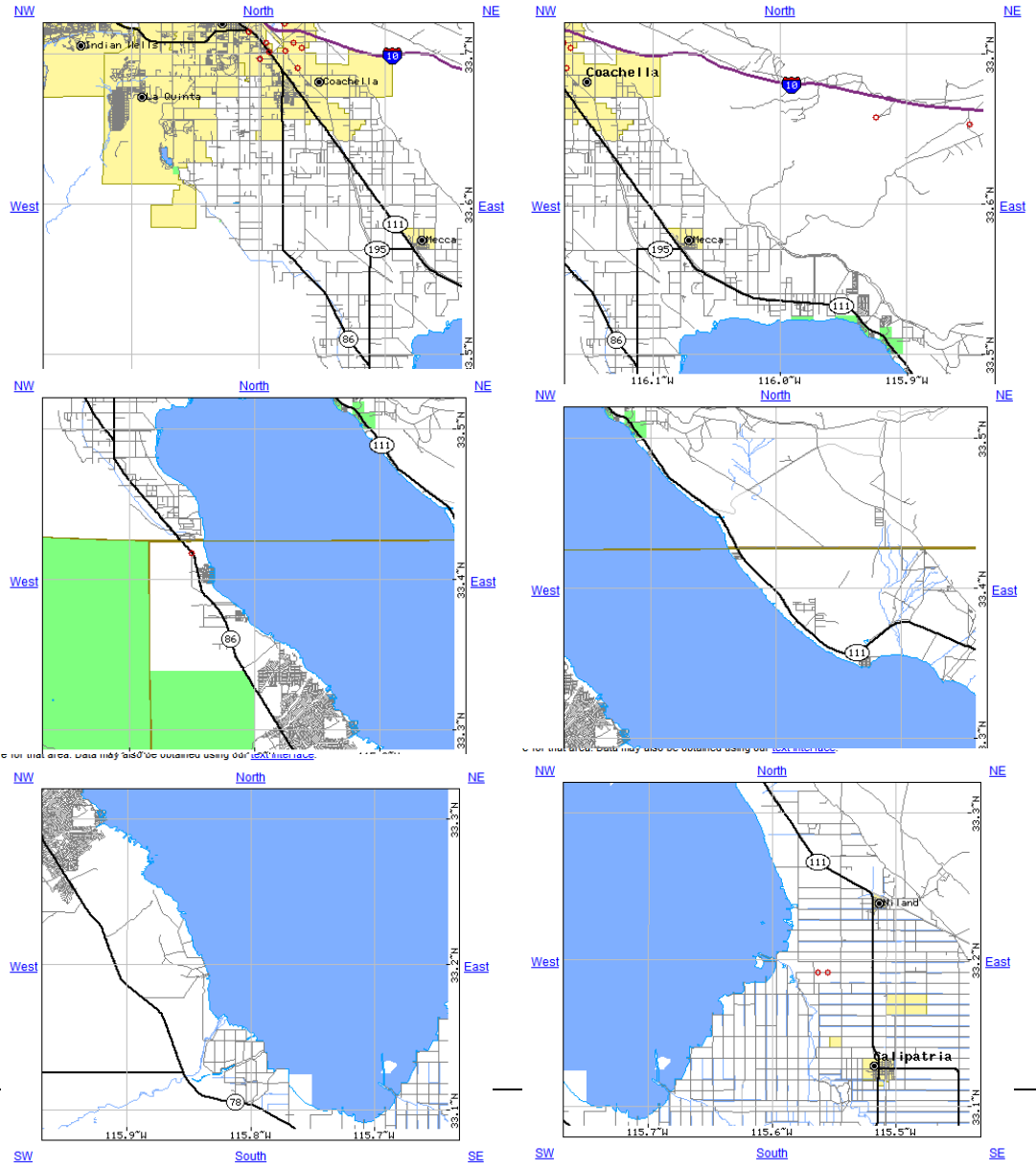
Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency
04-17-1989	-208.2	-208.2	7.6	-215.8	7.6			5000
05-22-1989	-208.2	-208.2	7.9	-216.1	7.9			5000
07-19-1989	-208.2	-208.2	8.1	-216.3	8.1			5000

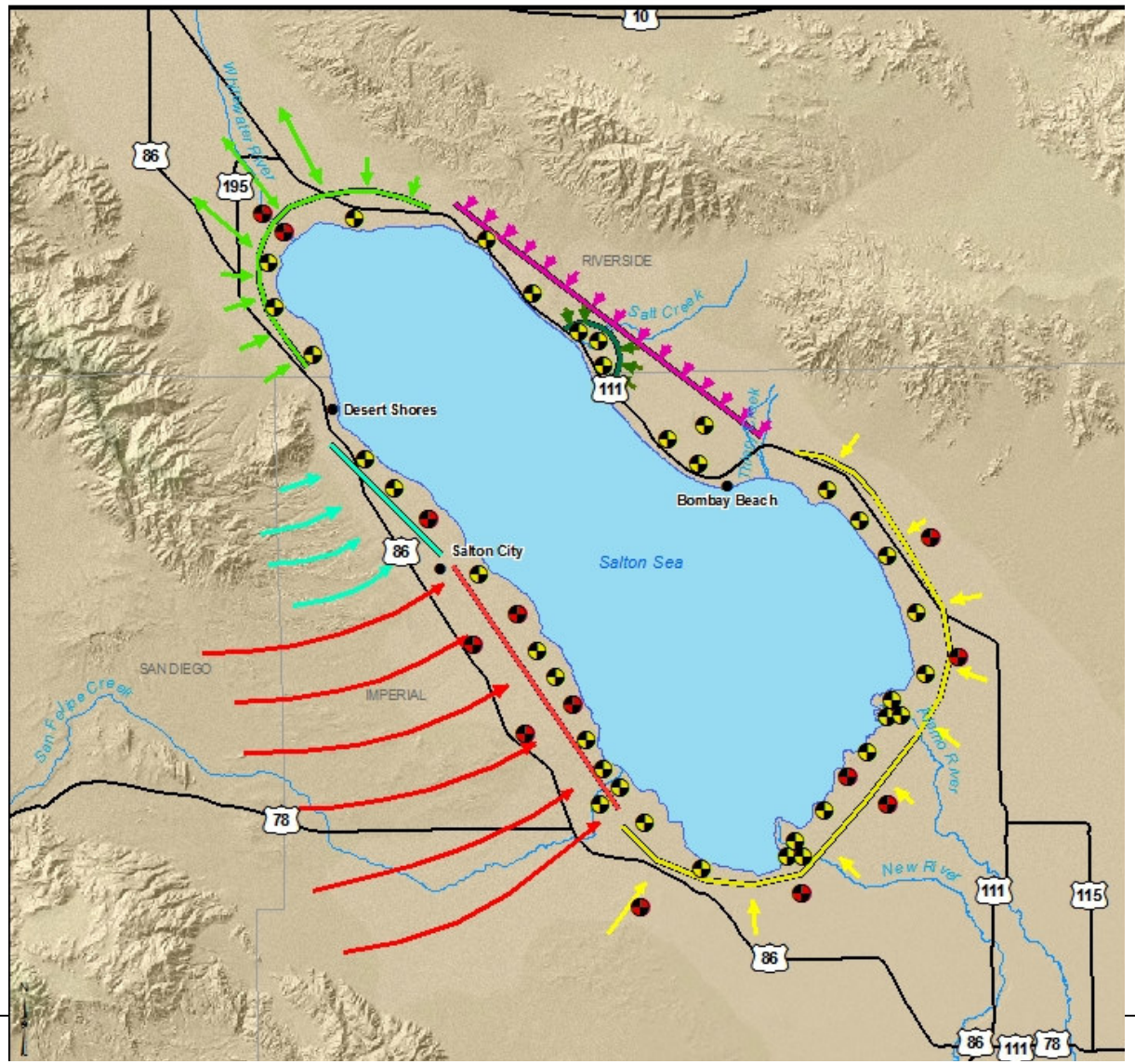
Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	634599	3673380	metres	11
LL	NAD27	115.5553	33.1909	decimal degrees	

Well Use: Undetermined

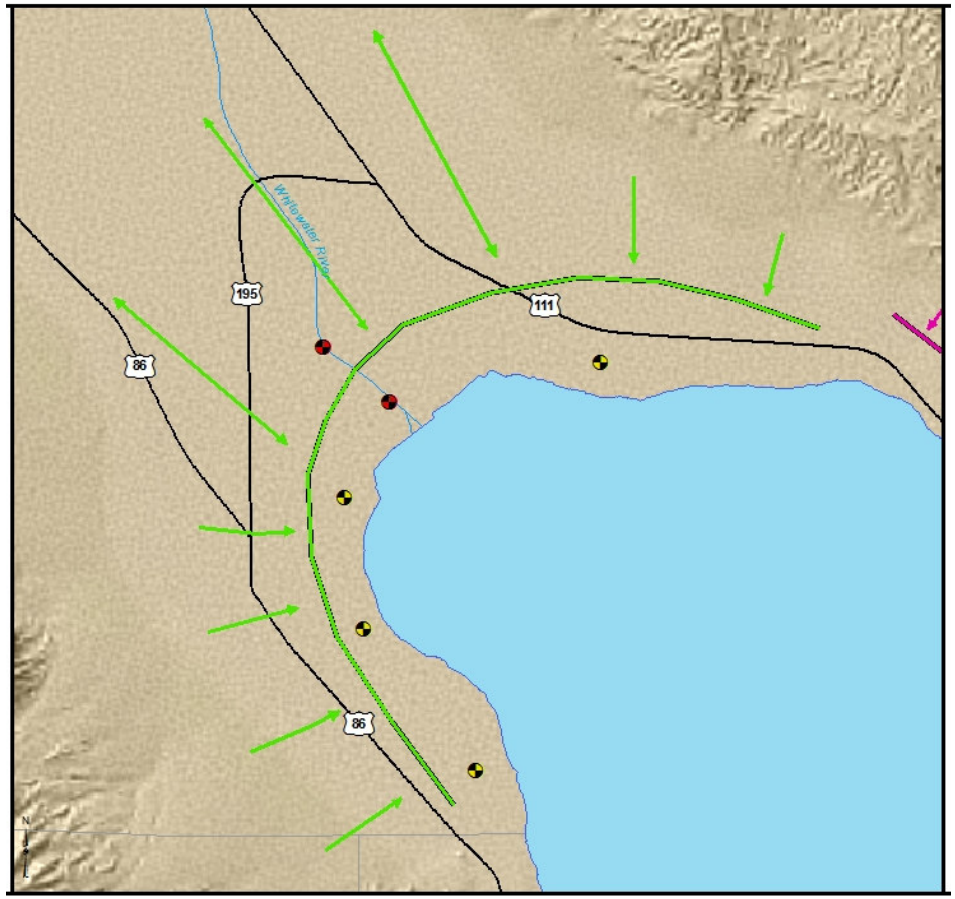


Conceptual Monitoring Network



Conceptual Monitoring Network – Coachella Valley

- Monitoring Objectives
  - Characterize flow to/from Coachella Valley
  - Characterize vertical gradients
  - Characterize groundwater chemistry
  - Evaluate saline habitat constructability issues

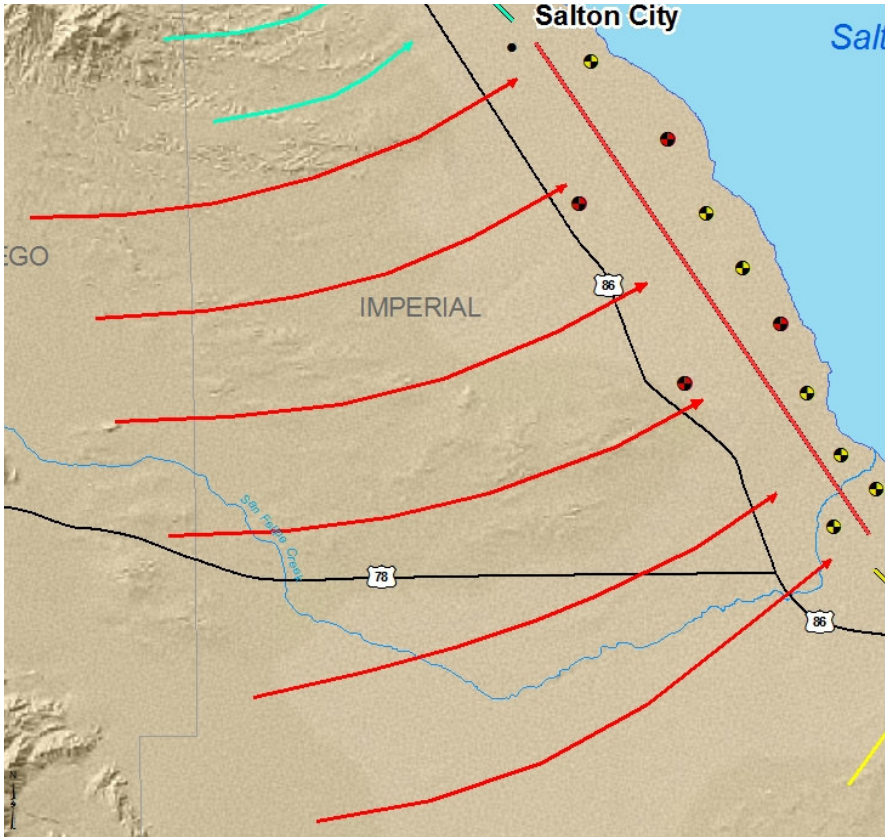


Conceptual Monitoring Network – Mountain Front (Desert Shores to Salton City)

- Monitoring Objectives
  - Characterize Mountain Front Recharge
  - Characterize vertical gradients
  - Characterize groundwater Chemistry

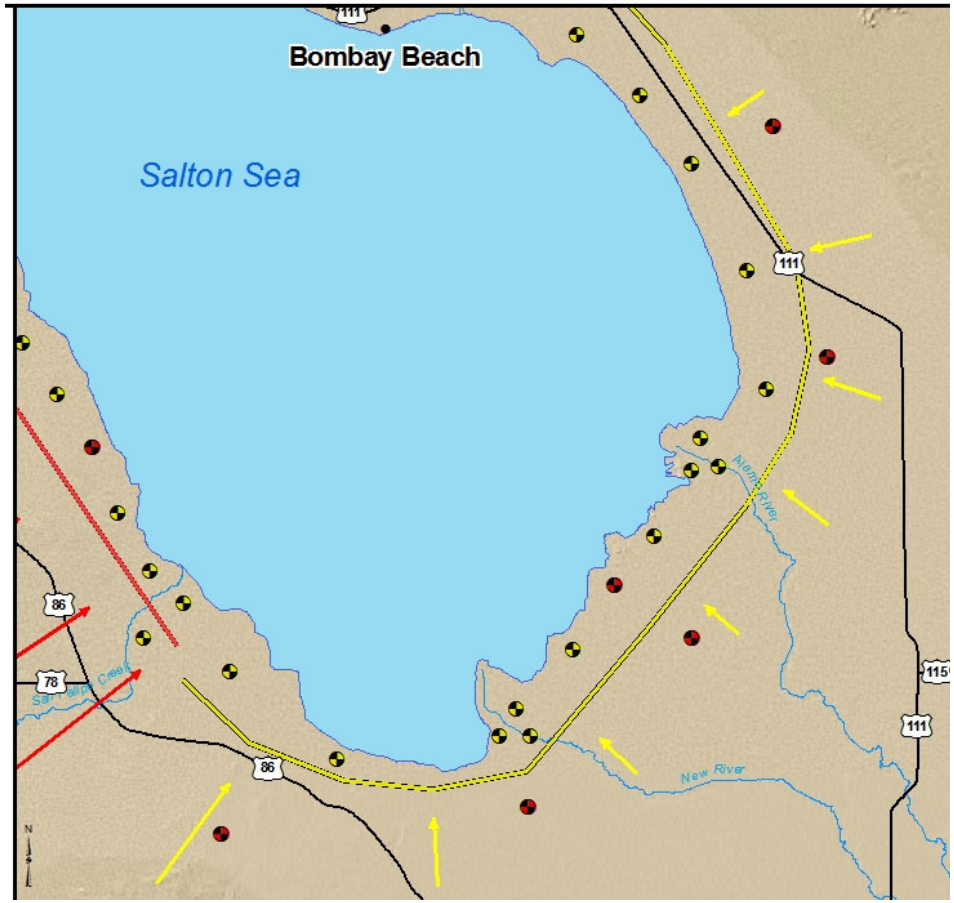
Conceptual Monitoring Network – Badlands / San Felipe Creek

- Monitoring Objectives
  - Characterize flow to/from Badlands / San Felipe Creek
  - Characterize vertical gradients
  - Characterize groundwater Chemistry



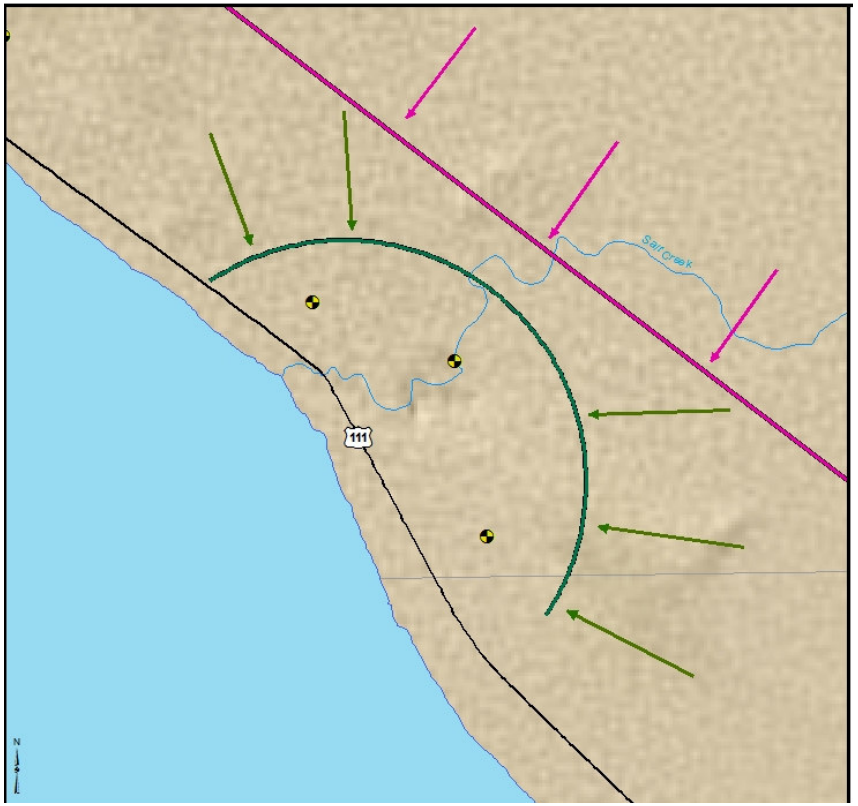
Conceptual Monitoring Network – Imperial Valley & Agricultural Drainage

- Monitoring Objectives
  - Characterize flow from Imperial Valley
  - Characterize vertical gradients
  - Characterize groundwater Chemistry
  - Evaluate saline habitat constructability Issues
  - Screen for Deep Groundwater Upwelling



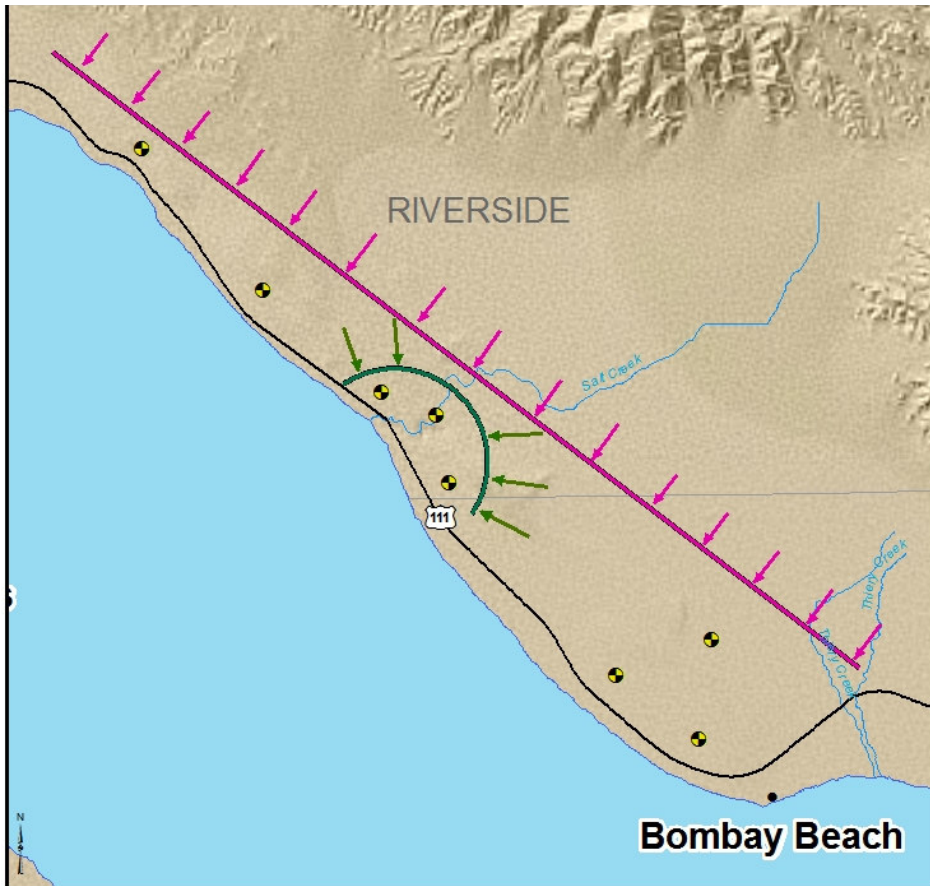
Conceptual Monitoring Network – Salt Creek

- Monitoring Objectives
  - Characterize discharges to / from Salt Creek
  - Characterize surface water / groundwater interactions
  - Track spring flows
  - Evaluate saline habitat constructability Issues



Conceptual Monitoring Network – East Sea Springs Area

- Monitoring Objectives
  - Characterize flow to Sea from springs
  - Evaluate San Andreas Fault Zone interactions with Groundwater flow
  - Characterize vertical gradients
  - Characterize groundwater Chemistry



Conceptual Monitoring Network – Deep Groundwater Upwelling

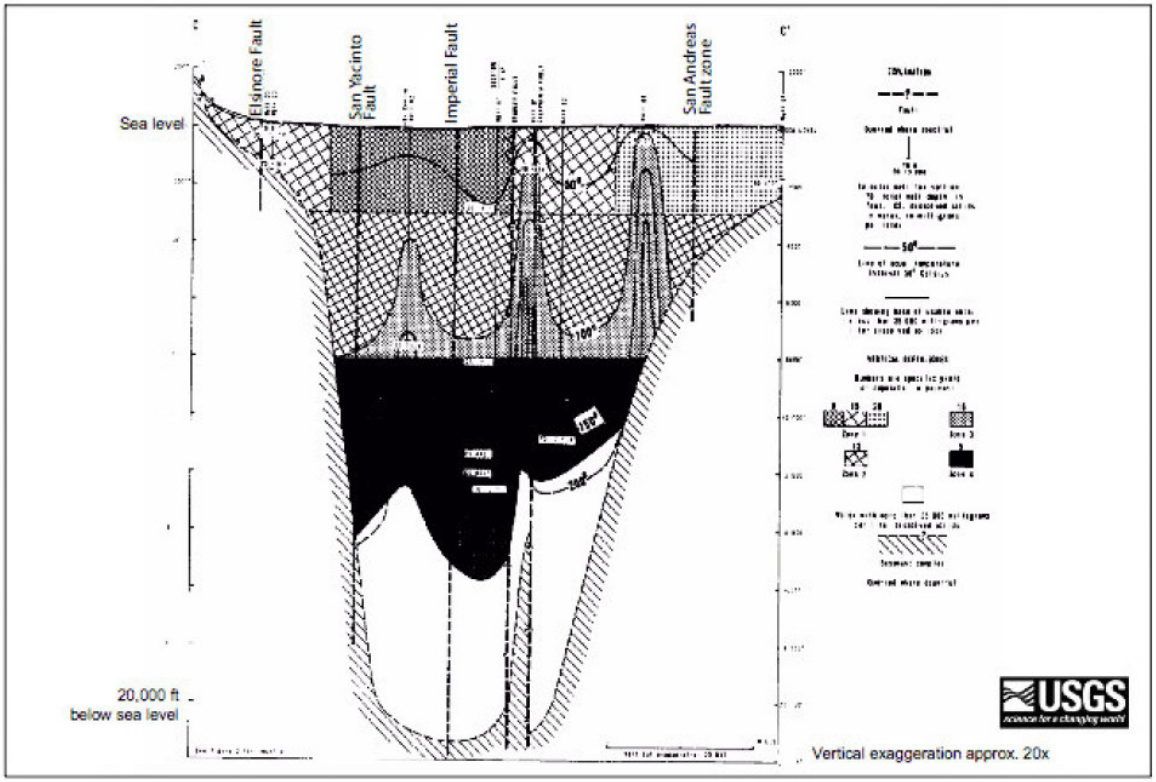


Figure 2.2: West to East geologic cross section through the deeper Salton Sea basin, approximately parallel with the US-Mexico Border (from Dutcher et al., 1972), showing inferred zones of specific yield (porosity) and groundwater temperature (°C).

Data Collection

- Water Level Elevation
- Standard physical parameters (Temp, DO, Turbidity, pH, EC, etc.)
- Groundwater Chemistry
  - General Inorganic chemistry
  - Select metals
  - Isotopes
  - Pesticides (downgradient of agricultural areas)

Monitoring Network

- Utilize existing wells to the extent possible
- Drill new single completion and nested monitoring wells to:
  - Define shallow (0 – 50 feet bgs) groundwater conditions
  - Define deep (50 – 200 feet bgs) groundwater conditions
  - Collect geochemical data
  - Evaluate groundwater gradients

Conceptual Prioritization

- Tier 1
  - Identify existing wells for integration into monitoring network
  - Develop understanding of shallow (0 – 50 feet) groundwater flow conditions
  - Develop understanding of shallow (0 – 50 feet) groundwater chemistry conditions
  - Utilize network to evaluate and predict constructability issues for any Saline Habitat Complex activities
  - Install shallow groundwater monitoring facilities
- Tier 2
  - Integrate vertical dimension into Tier 1 above
  - Evaluate vertical groundwater flow paths, chemistry gradients, and geothermal interactions
  - Install deeper (50 – 200 feet) groundwater monitoring facilities
- Tier 3
  - Complete deep exploratory borings
  - Integrate conceptual model (3 dimensions)
  - Develop numerical model (steady-state and transient)

Water Quality Monitoring Goals: Characterize and track……

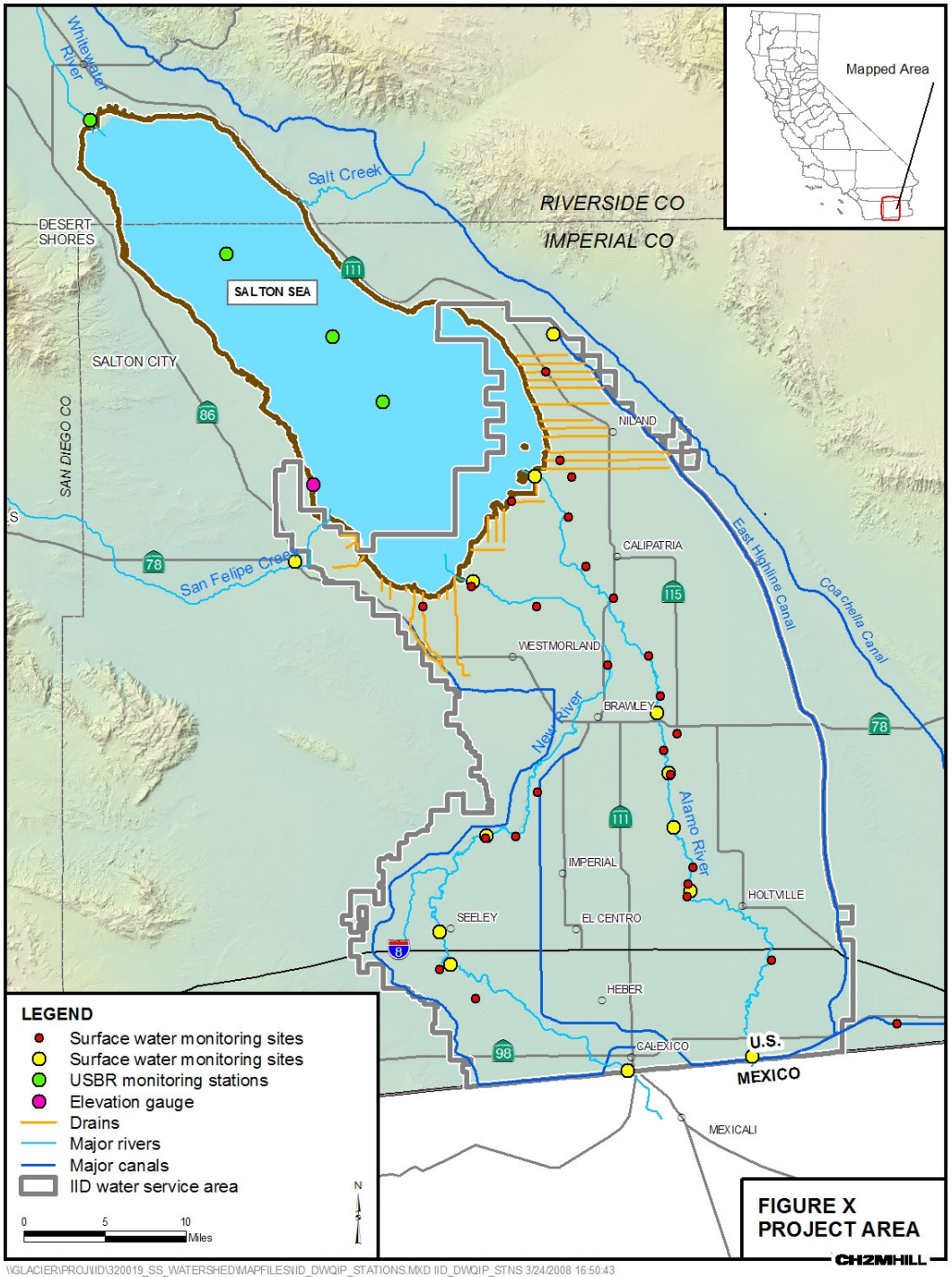
- …water quality of Salton Sea and various water supplies to Sea and future projects (i.e., SCH, wetlands).
- …sediment quality as a determinant of water quality and potential toxicity.
- …tissue chemistry of fish and invertebrates as measures of human health and ecological exposure.

Water Quality Monitoring Program

- Species Conservation Habitat: Focused Monitoring
  - Water supply: Drains, rivers
  - Sediment: In place
  - Water management: Retention time, seasonal flows.
- Existing and future Sea
  - Lake water and sediment. Track poor water quality events (hydrogen sulfide, DO, stratification)
  - Bioaccumulation in fish and invertebrates (selenium)
  - Rivers, Colorado River supply, and direct drains as source waters.

Tiered Water Quality Monitoring Approach

- Tier 1. Minimum characterizations: Rely on all existing programs for all water quality characterizations. No increase in frequency or locations (e.g. quarterly in Sea).
- Tier 2. Selectively add parameters, stations, and frequency (e.g., seasonally weekly) to adequately characterize all SHP inflows, sediments, and main Salton Sea water and sediment quality.
- Tier 3. Add focused studies on sulfide formation or selenium fate and transport (for example).


Mapped Area
Whitewater River
Salt Creek
RIVERSIDE CO
IMPERIAL CO
DESERT SHORES
SALTON SEA
SALTON CITY
SAN DIEGO CO
NILAND
CALIPATRIA
East Highline Canal
Coachella Canal
San Felipe Creek
WESTMORLAND
BRAWLEY
New River
Alamo River
IMPERIAL
HOLTVILLE
SEELEY
EL CENTRO
HEBER
CALEXICO
U.S.
MEXICO
MEXICALI
LEGEND
Surface water monitoring sites
Surface water monitoring sites
USBR monitoring stations
Elevation gauge
Drains
Major rivers
Major canals
IID water service area
0 5 10 Miles
N
FIGURE X
PROJECT AREA
CH2MHILL
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